TEXT INPUT METHOD FOR PERSONAL DIGITAL ASSISTANTS AND THE LIKE

DESCRIPTION

RELATED APPLICATION

The present application is related to U.S. Patent Application No. 09/_____ (Attorney Docket No. LX00071) entitled "Handwriting User Interface for Personal Digital Assistants and the Like" to Seni et al., assigned to the assignee of the present invention and filed **(either coincident or prior)**.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is related to personal digital assistants (PDAs) and more particularly to a user input interface for a PDA or the like.

Background Description

Portable computing devices, such as what is normally referred to as a personal digital assistant (PDA), are increasing in popularity. A typical PDA is a limited function microcomputer provided with a pressure sensitive liquid crystal diode (LCD) display (a touch pad or a touch screen) for input and output (I/O). PDAs are being adapted for wireless Internet communication, e.g., using a modem for e-mail and web browsing. Further, for text input PDAs are known that have a specialized stroke based alphabet interface, e.g., Graffiti®, a selectable on-screen QWERTY keypad, or an expansion pack keyboard.

As these portable devices become smaller and more specialized, text input has become more difficult and less practical. Typical prior art handwriting recognition software may require users to learn special characters or effect a handwriting style in order to enter text. Text input using the Graffiti® unistroke (i.e., written with a single pen trace) alphabet can be un-natural because it requires users to adhere to strict rules that restrict character shapes; text input using an on-screen QWERTY keypad is somewhat clumsy because only small reductions in size can be made to keyboards before they become awkward to use. An expansion keyboard is impractical for on-the-go input. With either, the tapping on individual characters or the typing is less desirable than being able to handwrite notes or messages. Meanwhile, the demand for PDA information exchange, e-mail and internet access requires entry and retrieval of increasing amounts of data with the handheld device.

Natural handwriting recognition (HWR) programs have been developed to add to function and usefulness to PDAs and are crucial to the growth of mobile computing in the communications field. To use handwriting recognition software, such as Transcriber (formerly known as CalliGrapher) from Microsoft Corporation, the user writes a message anywhere on the PDA screen, i.e., on top of any displayed application and system elements. Alternatively, the user can write in a designated input area using handwriting recognition software such as QuickPrintPro™ from Motorola, Inc., Lexicus division.

In order to handle unconstrained handwritten input (i.e., written in cursive style, print style, or using a combination of both) adequately, typically HWR programs such as those mentioned above, employ recognition algorithms that rely on dictionaries to constrain the search decoding space -- i.e., the space of possible letter sequences that can be matched to a given input ink. Users, however, often need to write otherwise non-sensical words (e.g. an e-mail address) that are outside of a typical system dictionary. For these situations the dictionary is useless and under some circumstances using a dictionary may actually impede correct recognition. However, HWR systems that are not, at least in part, dictionary based cannot support cursive writing where character boundary information is not available. Systems that are capable of generating both in and out of

dictionary recognition hypotheses simultaneously, typically exhibit lower in-dictionary accuracy.

Thus, there is a need for handwriting input user interface that includes the advantages of providing a dictionary for normal written word recognition, while at the same time allows users to enter any out-of-vocabulary character string.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, aspects and advantages will be better understood from the following detailed preferred embodiment description with reference to the drawings, in which:

Figure 1 shows a preferred embodiment handheld device with a user interface that includes separate handwriting input areas for words and for characters according to preferred embodiment of the present invention;

Figures 2A-B show handwritten text entry and recognition, wherein handwritten word entry begins in the word input area of the user interface;

Figures 3A-B show individual character entry and recognition in a character entry area of the user interface; and

Figure 4 is an example of a flow diagram for implementing the handwriting user interface of the preferred embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The present invention is a method of interfacing with and, a handwriting user interface (HUI) for, small (shirt pocket sized) portable devices with a touch-enabled input/output (I/O) screen, such as are commonly known as personal digital assistants (PDAs). The portable devices may be capable of wireless message transmission (such as for web browsing and/or e-mail). The user interface of the present invention is typically in software and loaded into storage in PDA. A state of the art handwriting recognition engine may be included, also in software. The present invention is particularly advantageous to entry of text, including character strings that are not necessarily words in a standard sense, e.g. acronyms, nmenonics or uniform resource locators (URLs). An entire character string, e.g. a URL, may be quickly handwritten, converted to ASCII text and, possibly, stored in the user dictionary for future reference, for example. Thus, the present invention enhances the usability, flexibility and power of the handheld device in which it is installed.

U.S. Patent Application No. 09/___________ (Attorney Docket No. LX00071 entitled "Handwriting User Interface for Personal Digital Assistants and the Like" to Seni et al., assigned to the assignee of the present invention, filed **(either coincident or prior)** and incorporated herein by reference, discloses a handwriting recognition user interface (HUI) which may be combined with the present invention for receiving text based handwritten entry. Handwritten entries are made at a designated input area on the touch screen, e.g., dimensions 0.30*H by W, where H and W are the height and width at the bottom of the device screen. Handwritten words are entered into the designated input area one at a time using a stylus. Recognition results are displayed in the normal display area of the screen above the designated input area.

Referring to Figure 1, a preferred handheld device 100 with a graphical user interface for entering handwritten text 102 according to the present invention is shown. Most preferably, the present invention is implemented in the user interface of Seni et al.

mentioned above, further designating respective word and character input areas 104, 106 within the designated input area 108 described therein. As shown, this input area 108 preferably resides on the lower third of the screen 102 with the area 109 thereabove reserved for display of screens associated with the device's various applications. Icons 110, 112, 114, 116 and 118 are disposed, for example, at the right side of the handwriting user interface 102 adjacent the input area 108. The icons 110, 112, 114, 116 and 118 provide access to functions such as inserting a space, backspacing, deleting, capitalizing recognition result, and undoing insertion of a last word recognition result. A scroll bar 120 is disposed, for example, at the right side of the interface display 102 adjacent the screen application area 109.

An entry that begins in the word input area 104 is treated as a handwritten word and recognition proceeds as described in Seni et al. However, when a handwritten entry begins in the character input area 106, that entry is treated as a single character and may be one character in a character string. Handwritten character entries are each matched against potential characters, e.g. characters in the particular PDA character set.

The device 100 may include a communications function and, to that end in this embodiment, an antenna 122 is shown at the top of the device 100. Individual function switches buttons and other controls are disposed about the device, as is deemed appropriate for the particular device. Preferably, the device 100 runs under a state of the art operating system for such handheld devices, e.g. Windows® CE from Microsoft Corporation, Epoc® from Symbian or the Palm OS® from Palm, Inc.

The preferred embodiment HUI of the present invention employs a handwriting recognition engine capable of recognizing handwritten words, written using any combination of writing styles (i.e., cursive, print, and mixed). Preferably, the recognition engine is the QuickPrintPro™ engine from Motorola, Inc., Lexicus Division. The recognition engine typically includes a main word dictionary and one or more user dictionaries to which the user may add words to supplement the main dictionary. User

dictionaries may include, for example, a word list, an e-mail address book, a bookmark/shortcut list, etc.

Figures 2A-B show handwritten text entry, wherein text entry begins in the word input area 104 in Figure 2A causing the entry to be recognized as a handwritten word and treated accordingly. To make a wider writing area available for word entry, upon first pen-down within the word input area, the character input area is removed and subsequently restored after completion of the word recognition operation. Thus, in Figure 2B after entry is complete, word candidates are presented in a pop-up list 130. Location of the pop-up list is not critical and so, to conserve space on the screen 102, the pop-up word list 130 can be displayed in the input area 108, and more specifically in the text or word input area 104 thereof.

The recognition engine compares a handwritten input word against all words contained in the main dictionary and the user dictionary. A probability score is generated by the recognition engine for each dictionary word which is indicative of the likelihood that the handwritten word matches that particular dictionary word. Based on each words' probability score, a list of likely matches is collected. From the recognition results, the handwriting recognition engine generates a confidence score for the one word (the primary word) with the highest probability score. If that confidence score exceeds a preselected confidence threshold, it is an indication that the recognition engine has correctly recognized the written word and that the primary word choice is in fact correct.

So, if the confidence level is above the preselected threshold, the HUI automatically loads a primary word choice into the device's input buffer for delivery to the active application. Thus, in the example of Figures 2A-B, that word may be automatically inserted into a displayed stream of recognized text such as in the upper area 131 of the display screen 102 in the application area 109 thereof. Otherwise, when the confidence level of the primary word choice is below the confidence threshold, an indication is provided that the recognition engine cannot find a likely candidate, e.g., displaying "???" or something similar into the device's input buffer. If the correct word is

not in the pop-up list the user can either rewrite the word or "back-off" to character-by-character input in the character writing area.

Handwritten text input entry may be provided in unrestricted mixed style that includes cursive (i.e., contiguous characters in each word touching or connected), pure print (i.e., characters in every word disconnected and do not touch), pseudo-print (at most pairs of characters in words touch) or any combination thereof. Thus, for mixed entry a user is not restricted to cursive, print or pseudo-print entry. The user may designate that text entry is to be in one mode only, i.e., cursive, pure print or pseudo print. Thus, the number and complexity of created character alternatives possible are reduced for the handwriting recognition engine, increasing both recognition accuracy and speed.

Figures 3A-B show individual character entry wherein characters are entered in the character input area 106. Individual characters may be entered as part of a non-textual string (e.g., an e-mail address) or to correct a misspelled previously entered word identified by tapping on the word to select it, for example. Preferably the character writing area is defined as "modal" such that the possibilities of the user's character input are selectively limited in order to increase recognition accuracy. Selectable modes may include "digits," "symbols," "upper-case letters" and "lower-case letters" modes.

Entry begins in the character input area 106 in Figure 3A, causing an entry to be recognized as an individual handwritten character and treated accordingly. Compared to word recognition, individual character recognition is a relatively simple task for a typical state of the art handwriting recognition engine. Further, to increase the likelihood of presenting the user with the correct character, a pop-up list 132 is provided as shown in Figure 3B, listing likely characters in descending order of likelihood. This character list 132 can be disposed in the same space as where the word list 130 would be when it is displayed, i.e. in the area 104 directly adjacent area 106. As each character is accepted, it is inserted at the end of an output string of characters (not shown) displayed above the input area 108. Optionally, a string of characters entered using the character writing area can be logged and automatically added to the user dictionary for future writing in the

word input area. If the character is being provided to correct a misspelled or misrecognized word, then the recognized character(s) are inserted at a selected position into the word, e.g., hap_y.

Figure 4 is an example of a flow diagram of a method 140 for implementing the handwriting user interface of the preferred embodiment of the present invention. First, in step 142 a handwritten entry is made into the designated screen input area. In step 144 a check is made to determine whether the handwritten entry is in the text input area 104 or character input area 106. If the handwritten entry is in the text input area 104 in step 146, the handwriting recognition engine matches the handwritten input as described in Seni et al. Otherwise, in step 148 a probability score is generated for each possible character to indicate the likelihood that the input character is that particular character. In step 150, the highest scoring characters are identified. In step 152 the top scoring characters are displayed in a pop-up list 132. In step 154, the user selects the correct character and that selected character is inserted into or at the end of the character string in the input buffer and displayed above the input area 108. Then, returning to step 142, the user is allowed to continue character or word entry.

Thus, the present invention provides a simple, easy to use interface for entering non-textual character strings in a handwriting enabled shirt-pocket sized device.

While the invention has been described in terms of preferred embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the appended claims.